

SEDATION/ANALGESIA PATIENT MONITOR COURSE

KIMBROUGH AMBULATORY CARE CENTER

FT. GEORGE G. MEADE, MARYLAND

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Welcome to the Sedation/Analgesia Patient Monitor Course. As the administration of intravenous sedation/analgesic medications for patients undergoing minor procedures has increased, the need for policies to standardize the quality of patient care has developed. Included in this policy is the provision for the training of personnel in patient education, assessment and monitoring competencies. This course is the first of two phases required before you may assist with sedation/analgesia procedures. The didactic phase covers areas of monitoring, pharmacology, airway management and legal responsibilities. Once you have successfully completed this phase, you will then act as the patient monitor during an invasive procedure requiring the use of sedative/analgesic medications under the tutelage of the charge nurse, gastroenterology service. Having successfully demonstrated your ability to monitor these patients safely, you will be able to serve as a certified patient monitor within the clinic. The charge nurse, gastroenterology service, will conduct annual verification of skills. Documentation of this certification should be placed in your Education Six-Part Folder.

This instruction is self-paced. There is a companion videotape available. Contact the Chief, Anesthesia Service, if you would like to sign it out, (301-677-8018). Once you complete the course, print page 29 (Answer Sheet) and record your answers. Forward the sheet to the Chief, Anesthesia Service, Kimbrough Ambulatory Care Center, FGGM, MD 20755. Your posttest will be graded and you will be notified. Please do not hesitate to seek help/clarification from the Chief, Anesthesia Service at any time.

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Sedation/Analgesia Performance Objectives

Identify with 100% accuracy the state of sedation (minimal sedation, moderate sedation, deep sedation or anesthesia) by assessing respirations, protective airway reflexes, and level of consciousness.

Classify without error the commonly used pharmacological agents according to their action (anxiolytic, sedative-hypnotic or analgesic) and chemical class (benzodiazepine, barbiturate, antihistamine or opioid).

Select from a list situations for which the sedation/analgesia protocol is not intended.

List situations requiring consultation with anesthesia before providing sedation/analgesia.

Identify from a list, competency requirements related to the provision of sedation/analgesia.

List monitoring parameters that must be recorded every 5 minutes during the procedure.

Given orders for sedative/analgesic medications, demonstrate correct administration including titrating to effect (Registered Nurses only).

Identify discharge parameters including level of consciousness, vital signs, time since reversal agent and patient/family education.

List common complications arising from administration of sedation/analgesic medications and recognize which is most common.

Correctly handle complications occurring during sedation/analgesia scenarios.

Identify legal implications involving the RN providing sedation/analgesia.

Definitions:

In order to know how sedated your patient is, you must be familiar with a few definitions. Practicing within the confines of sedation/analgesia mandates that your patient does not become too sedated. A few important definitions are listed below. By referring to these definitions, you can see that any patient who requires any airway assistance, or who has stopped following commands has progressed to a level of sedation that is beyond the scope and intent of sedation/analgesia protocols.

It is important to realize that sedation is not the only objective with most patients. It is true that we want our patients relaxed, however we usually want to provide analgesia as well. For this reason, the term "conscious sedation" was replaced with "sedation/analgesia."

Helpful Hint

Rather than memorizing these definitions, remember this:

- If a patient has received any sedative/analgesic medication at all, they are at least minimally sedated.
- If a patient becomes difficult to arouse or loses the ability to maintain a continuously patent airway, then they have gone past moderate sedation to deep sedation. Notify the physician provider, provide active airway management, and consider reversal agents.

ANALGESIA - Insensibility to painful stimuli without the loss of consciousness.

ANXIOLYTIC THERAPY - Administration of medication for the purpose of alleviating anxiety or claustrophobia. Does not result in an alteration of consciousness but rather enhances coping skills of the patient.

SEDATION - The production of a state of lessened activity, or the act of allaying anxiety and irritability, or the amelioration of pain.

MIMIMAL SEDATION (Anxiolysis):

A drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected. Amnesia may or may not be present. The patient is technically awake, but under the influence of the drug administered.

MODERATE SEDATION/ANALGESIA (“Conscious Sedation”):

A drug-induced depression of consciousness during which patients respond purposefully (reflex withdrawal from a painful stimulus is not considered a purposeful response.) to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.

DEEP SEDATION/ANALGESIA:

A drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained.

ANESTHESIA:

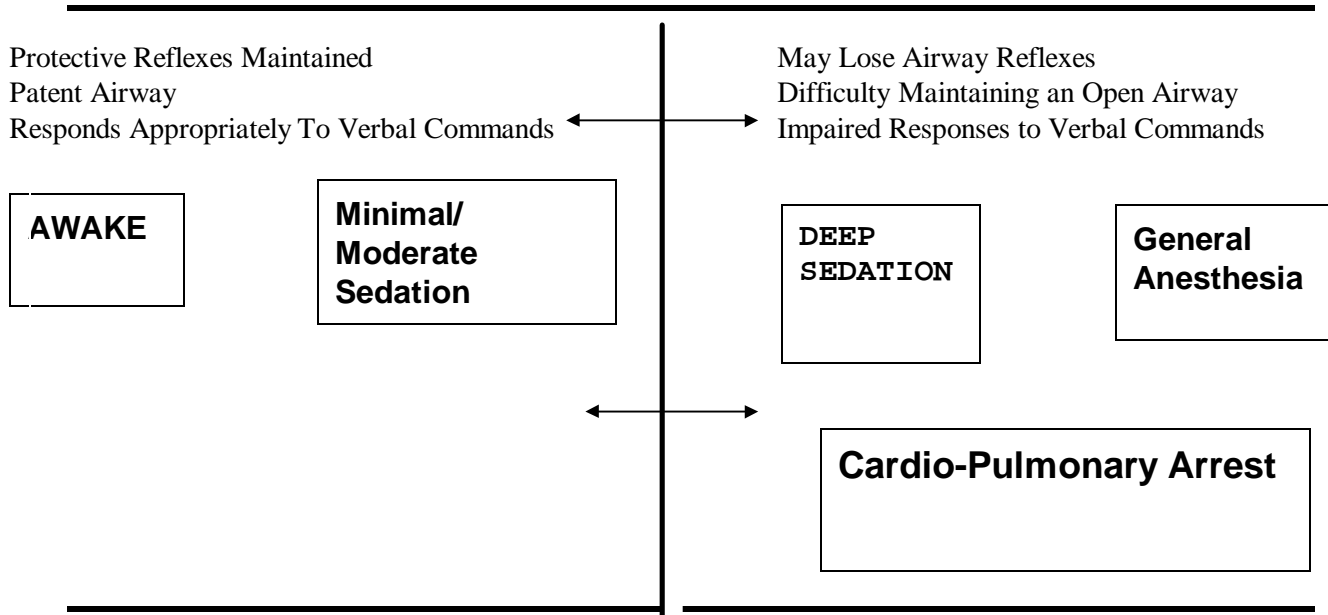
Consists of general anesthesia and spinal or major regional anesthesia. It does not include local anesthesia. General anesthesia is a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function. Cardiovascular function may be impaired.

Clinic Protocol: Before you monitor a patient who is receiving sedation/analgesia for a diagnostic or therapeutic procedure, it is important for you to be familiar with the clinic protocol on sedation/analgesia. You may wish to go to the KACC Regulations found on the KACC Website (<http://www.narmc.amedd.army.mil/kacc>) and review **KACC Reg 40-17, Conscious Sedation.**

When administering any medication, the intent of the provider dictates the purpose of the medication. There is a continuum in the administration of analgesics, anxiolytics and/or amnestics from the provision of sedation to the induction of general anesthesia. Sedation/analgesia lies along this continuum.

If it is the intent of the administrator is to provide relief of pain from an injury or illness then the medication is for analgesia. If the same medication is given with the intent to relieve pain and/or anxiety associated with a procedure then the medication is for sedation. The medication itself does not determine whether administration is for sedation or

analgesia - the key is the physician's intent.



Scope of practice:

The provision of sedation/analgesia is an interdependent role, requiring a physician's order prior to implementation. The purpose is to obtund, dull, or reduce the intensity of pain and awareness without the loss of protective reflexes (i.e. airway) during procedures. Sedation/analgesia assists patients in tolerating unpleasant procedures by relieving anxiety, discomfort, or pain in situations that are not particularly uncomfortable, but require that they not move. Sedation/analgesia can be administered only in designated areas meeting all criteria in the protocol. The physician rendering care must have specific clinical privileges prior to administering any sedation/analgesic medications. The provider must also have current ACLS certification.

The patient monitor must also have proven competency by successfully completing this course. The patient monitor must have, at a minimum, BLS certification. ACLS certification is strongly encouraged.

Exclusion Criteria:

The following situations are not covered by the sedation/analgesia protocol:

- Patients receiving sedating doses of drugs for seizure control or for pain management.
- Situations where it is anticipated that sedation/analgesia would likely result in a loss of protective mechanisms/reflexes, purposeful responses to verbal commands, or tactile stimulation.
- Perioperative management of patients requiring general anesthesia or monitored anesthesia care.
- Patients with severe systemic disease that is activity limiting, incapacitating or life threatening.
- Pediatric patients under the age of 5. (Anesthesia staff will provide sedation/monitoring.)
- Pediatric patients under the age of 5. (Will be performed in the operating room, unless the procedure requires a special location and/or special equipment.)
- Patients who have not been NPO for a minimum of 6 hours.

Competency Validation:

The following are the criteria for providing sedation/analgesia patient monitoring within the MEDDAC:

- The patient monitor must successfully complete this course as verified by the Chief, Anesthesia Service.

- Sedation/analgesia competency will be revalidated every year.
- The provider must have current BLS certification. It is strongly recommended that ACLS certification be obtained.
- The physician ordering or administering sedative/analgesic medications must have specific clinical privileges.

Equipment:

Appropriate emergency equipment for maintaining the patient's airway, ventilatory status and cardiac status will be readily available when sedation/analgesic medications are given to the patient. Equipment must be suitable for the size and age of the patient. The following equipment is essential, but not limited to:

- Emergency cart with defibrillator (immediately accessible)
- Suction device
- Oxygen and oxygen delivery devices (cannula, mask)
- Appropriate oral and nasal airways (pediatric and adult as appropriate)
- Continuous noninvasive BP monitoring device
- Cardiac monitor
- Pulse oximeter
- Ambu bag/mask
- Intubation tray
- Reversal agents (naloxone and flumazenil)
- IV supplies

Indications for Sedation/Analgesia:

Each patient care area, which utilizes providers for sedation/analgesia, must have specific structure standards that include:

- Pre-determined exclusion criteria for patients who are not candidates for sedation/analgesia.
- A written protocol to ensure continuous monitoring of patients throughout the procedure, as well as the recovery phase.
- Instructions for medication administration to include drugs, drug routes, and amounts recommended for administration.
- Written guidelines for managing potential complications or emergency situations.

Consulting Anesthesia:

Consultation with the anesthesia service is mandatory before providing sedation/analgesia in the following situations. If any items on this checklist apply, please consult with the anesthesia service.

- Uncooperative patients
- Sleep apnea
- Pregnancy
- Age extremes
- Patients with severe cardiac, pulmonary, hepatic, renal or CNS disease
- Drug or alcohol abuse
- Morbid obesity
- Emergency/unprepared patients
- Patients requiring deep sedation
- Metabolic and airway difficulties

Furthermore, the anesthesia service must be consulted immediately in situations where the patient is observed to have lost protective reflexes, become unresponsive, or become apneic.

Duties:

Personnel caring for the patient receiving sedation/analgesic medications will not have other responsibilities that would leave the patient unattended. Any distraction from monitoring the patient compromises patient safety. In other words, the patient monitor cannot participate in the procedure being performed, cannot leave the bedside to take care of another patient, nor delegate monitoring to someone not having completed this training.

RESPONSIBILITIES OF THE PATIENT MONITOR:

1. Preparation of the patient and family.
2. Assembling and testing of monitoring equipment.
3. Placement of an intravenous catheter, if allowed by individual scope of practice.
4. Monitoring of the patient during and after the procedure
5. Recognizing and responding to untoward reactions.
6. Determination of suitability for discharge by using the established discharge criteria.
7. Providing clear discharge instructions to the patient and/or family.

GOALS OF SEDATION/ANALGESIA:

1. Sedation/anxiolysis - Adequate to allow for required procedure to be performed. Patient remains responsive to verbal/tactile stimuli and retains ability to manage own airway.
2. Amnesia - preferred but not required
3. Analgesia - may be provided by narcotic, NSAID, and/or local anesthetic
4. Ability to maintain spontaneous ventilations
5. Maintenance of autonomic stability

Monitoring Requirements:

The pre-procedure and intra-procedure requirements for assessment and documentation are given below. The post-procedure requirements are discussed in the section "discharge requirements."

Pre-procedure Monitoring Requirements:

- The physician will select and order the procedure and medication. Documentation of these orders must be in the patient's chart and communicated prior to the procedure.
- Obtain proper consent for procedure and sedation.
- Verify that the patient has a capable adult escort.
- Perform a relevant history interview (physician/nurse).
- Determine prior sedation/anesthesia history with associated problems.
- Determine drug and alcohol history.
- Perform/review a focused physical assessment to include heart, lungs and airway.
- Assess and document mental status, level of anxiety, and level of consciousness.
- Document and communicate drug allergies (wrist band and tape on front of chart).
- Determine and document weight and age of patient.
- Determine and document current medications.
- Determine and document concurrent medical problems.
- Determine and document baseline vital signs (BP, H.R, T, SaO₂).
- Verify patient has been without food and drink for at least 6 hours.
- Review the physician parameters for O₂ saturation and titration of oxygen.
- Establish and confirm IV access.

- Perform and document patient education and counseling for sedation and the procedure (risks involved, benefits, limitations, alternatives.)

Monitoring During the Procedure:

- Monitor blood pressure, pulse, respiratory rate, level of consciousness, and arterial oxygen saturation continuously during the procedure. Documentation is required at a minimum of every 5 minutes. Routine blood pressure monitoring with the sedation of children often causes unnecessary stimulation, resulting in awakening. For this reason, blood pressures are taken pre- and post-procedure and at intervals based on patient needs and clinician judgment.
- Continue to monitor and record ventilatory function. The patient monitor will inform the physician of any changes in patient condition or drop in SaO₂ below 92%, or the ordered parameter.
- Monitor response to verbal commands when practical (thumbs-up) in response to verbal or tactile stimulation.
- Electrocardiograph monitoring should be used in patients with significant cardiovascular disease as well as during procedures where dysrhythmias are anticipated.

Discharge Requirements:

The recovery and discharge procedure is as follows:

- Monitor and record the level of consciousness and vital signs (BP, P, SaO₂, and frequency and depth of respiration in the absence of stimulation).
- Notify the physician if vital signs fall outside of the limits previously established for each patient.
- Notify the physician if the patient does not return to their baseline level of consciousness. Patients must be alert and oriented prior to discharge.
- Ensure that sufficient time (up to 2 hours) has elapsed following the last administration of reversal agents to ensure that patients do not become resedated.
- Discharge outpatients in the care of a responsible adult who will accompany them home and be able to report post-procedure complications.
- Provide outpatients with written instructions regarding post-procedure diet, medications, activities, and a phone number to call in case of emergency.

MONITORING

The sedation/analgesia protocol mandates continuous monitoring of blood pressure, pulse, respiratory rate, level of consciousness and arterial oxygen saturation. These parameters will be documented at a minimum of every 15 minutes. It will be assumed that the reader is familiar with most of these devices, since a prerequisite to safe patient monitoring includes education in these matters. This chapter will focus on how these devices function and discuss their limitations.

Visual Assessments:

Before discussing the mechanical monitoring devices, it is important emphasize that the most important monitoring device is the skill of the clinician. When monitors fail, a finger on the pulse can reveal rate, rhythm and strength of cardiac pulsations. The "ABCs" of basic life support should not be forgotten when high-tech monitors are used: Does the patient have a patent airway? Are they breathing? Do they have adequate circulation? With this in mind, we will discuss how the mechanical monitors work.

Pulse:

Heart rate can be measured in multiple ways:

Electrocardiogram

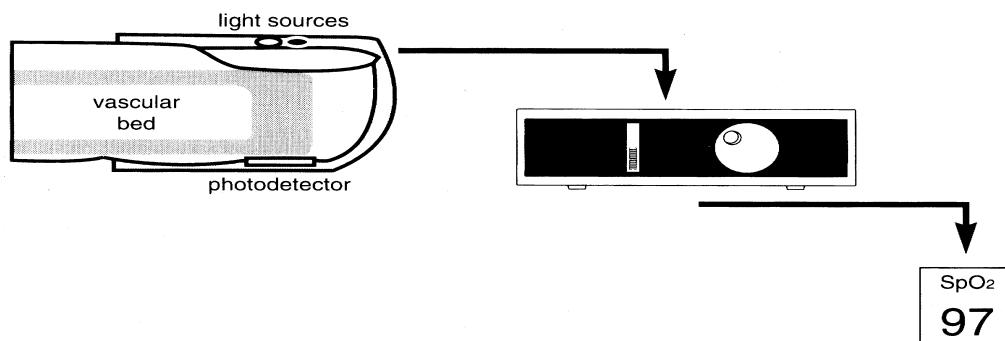
The ECG provides information on the cardiac conductivity of the heart, but does not indicate what pulse is generated from that activity. In most instances the pulse rate matches the ECG rate, and is usually an accurate indicator of pulse rate. In situations where the ECG is showing a regular heart rate, but no pulse is generated (and therefore no blood pressure), an electromechanical dissociation is occurring, and ACLS protocols should be initiated. Continuous ECG monitoring can also give early indication of dysrhythmias associated with hypoxia or coexisting disease.

Direct measurements

The pulse oximeter and blood pressure cuff require a pulse for reading and are reliable indicators of the patient's pulse. Best assessments of the quality of the pulse are measured through direct palpation or auscultation, and when the patient monitor has any doubts, these methods should be used immediately.

Pulse Oximetry:

Studies have proven that respiratory events occur frequently during and shortly after sedation/analgesia, and that far more of these are recognized when pulse oximetry is continuously used. Indeed, pulse oximetry is a standard of care in anesthesia.



How it works

The absorption of light passing through a sample of hemoglobin is a logarithmic function of its oxygen saturation. Two wavelengths of light are typically used to distinguish oxyhemoglobin from reduced hemoglobin, 660 nm and 940 nm. This technology is called spectrophotometry. In addition, pulse oximeters use plethysmography to distinguish between arterial, pulsating blood and venous, non-pulsatile blood.

Limitations

Pulse oximetry (SpO_2) will differ from arterial oxygen saturation (SaO_2) in a few situations; when there is a significant amount of carboxyhemoglobin or met hemoglobin in the blood; when the oxygen saturation falls off of the steep part of the oxyhemoglobin dissociation curve (SaO_2 less than 70%); or when there is a substance in the blood that absorbs light in the red or infrared spectrum, such as methylene blue.

The pulse oximeter has other limitations as well. Hypotension, hypothermia or the use of vasoconstricting drugs may reduce the pulsatile flow. Ambient light may interfere and cause incorrect readings. Motion of a finger probe may cause failure. The pulse oximeter detects adequacy of **oxygenation**, but fails to detect adequacy of **ventilation** (carbon dioxide exchange), and may miss a significant amount of hypoventilation. With these limitations in mind, however, pulse oximetry provides valuable and early information during procedures using sedation and analgesia.

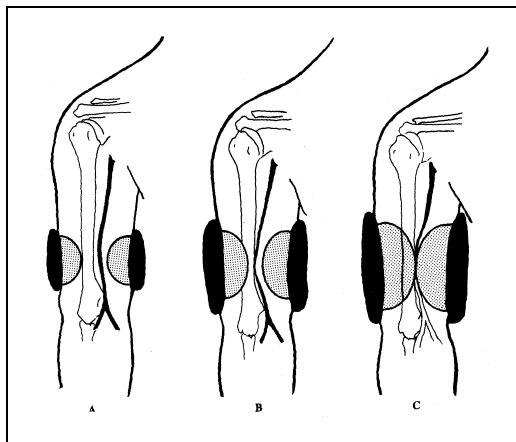
Helpful Hint

A patient who is hypoventilating may still be demonstrating adequate pulse oximetry readings, especially when supplemental oxygen is given. This is because **oxygenation is not the same as ventilation**. In order to monitor the adequacy of ventilation, capnography may be used in addition to pulse oximetry. An acceptable pulse oximetry reading does not insure adequate **ventilation**. It should also be noted that under normal conditions, a pulse oximetry reading of 90% correlates with a PaO_2 of 60mmHg.

Automated Blood Pressure Cuffs:

How it works

Automated non-invasive measurements of blood pressure frequently use the technology of oscillometry. This technology is felt to be a reliable representation of true arterial blood pressure. With this technology the points of maximal fluctuations in cuff pressure are sensed while the cuff is deflated. In a typical microprocessor-controlled oscillotonometer, the cuff is inflated with an air pump and the pressure is held constant while a sample of oscillations is gathered. If no oscillations are detected, some of the pressure is relieved and another sample is gathered. This is repeated in a step-wise fashion, and algorithms are used to filter artifact.



Cuff size

Proper cuff size and fit are required for adequate measurement. Falsely low estimates will be generated if the cuff is too large, and falsely high estimates will be generated if the cuff is too small. The cuff is considered the proper size when the bladder width is approximately 40% of the circumference of the extremity and the bladder length is sufficient to encircle at least 60% of the extremity.

PHARMACOLOGY

In this chapter you will learn basic principles of pharmacology as it relates to sedative/analgesic medications. You will learn general information about a variety of drug classifications, as well as dosage and side-effect information about specific drugs.

Helpful Hint: The ordered dose of medication is an end point. Start off by giving half of the ordered dose and wait for a response. If no adverse side effects occur and the patient needs more, then titrate the rest of the ordered dose.

Opioids

Natural opioids are derived from the poppy plant, which contains as many as 20 pharmacologically active alkaloids, the chief constituent of which is morphine. In addition, many synthetic opioids have been developed, each with distinct pharmacological characteristics. Opioids are usually classified by their chemical structure. Of the purely synthetic opioids, the phenylpiperidine series is the most important. Opioids in this series include meperidine, fentanyl and the fentanyl analogs.

Opioid receptors are located throughout the brain and spinal cord, and consist of several types, including mu (μ), kappa (κ), delta (δ) and sigma (σ). The most important types of receptors in opioid pharmacology are mu and kappa, which provide analgesia. Mu receptors can be further subdivided into μ_1 and μ_2 . Stimulation of μ_2 receptors produces respiratory depression. Most pharmacological agents that stimulate mu receptors do not preferentially bind to μ_1 or μ_2 , therefore **respiratory depression** is a concern with the administration of mu-receptor agonists.

Common features of opioids include: 1) Central analgesic effect on the dorsal horn of the spinal cord, 2) mood elevation, 3) cough suppression with certain chemical classes, 4) respiratory depression, 5) nausea and vomiting, 6) decreased gastric emptying and reduced intestinal motility, 7) constriction of pupils, and 8) urinary retention. (See Table below)

TYPE	ANALGESIA	OCULAR EFFECTS	GI EFFECTS	GU EFFECTS	RESP EFFECTS	OTHER
μ_1	Supraspinal Euphoria	Miosis	Nausea/Vomiting	Retention		Pruritus
μ_2	Sedation		Transit inhibition		Depression	
Kappa	Spinal Sedation	Miosis		Diuresis	Depression	
Sigma	Dysphoria Hallucination	Mydriasis			Tachypnea	
Delta	Spinal		Nausea/Vomiting	Retention	Depression	Pruritus Dependence

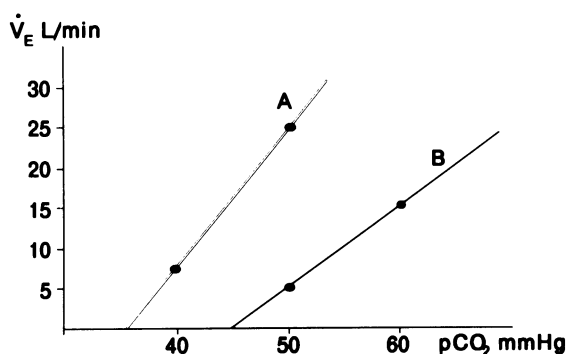
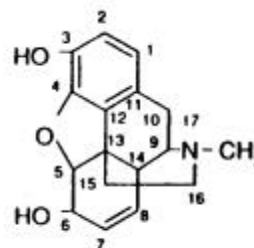
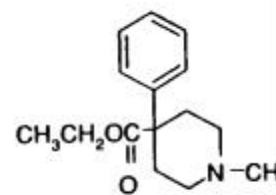


Fig. 4-3 Ventilatory response to progressive increases in CO₂ (A) before and (B) after an opioid agonist. Note that after opioid administration the apneic threshold is increased (elevated PaCO₂ intercept) and the response curve is both shifted to the right and of a lesser slope.

Respiratory depression is the most serious side effect of opioid administration during sedation/analgesia, and an understanding of this mechanism is important. At low doses of opioids, tidal volume is unaffected and only respiratory rate is decreased. At increasing doses, both tidal volume and respiratory rate are affected. It is important to note the effect of opioids on ventilatory drive. In healthy individuals who have not been administered opioids, ventilatory drive is due largely to the level of carbon dioxide in the blood. The administration of opioids alters the ventilatory response to carbon dioxide, and shifts the driving mechanism to hypoxia. It is therefore possible to further diminish the respiratory drive by delivering high concentrations of supplementary oxygen.



Morphine



Meperidine

Fentanyl

The potency of fentanyl is on the order of 100-times that of morphine. Given in 25 mcg increments to a total dose of 1mcg/kg, it has a duration of action of .5-1 hour, making it a good choice for short diagnostic or therapeutic procedures.

Meperidine

Meperidine was the first synthetic opioid to be introduced into clinical practice. It is less potent than morphine for 75 mg of meperidine is equivalent to 10 mg of morphine. It is usually given in increments of 12.5 mg to a total dose of 1.0 mg/kg. The duration of action is 1-2 hours. Unlike other opioids, meperidine does not tend to have a vagolytic (bradycardia) effect, due to its atropine-like chemical structure. Meperidine can cause histamine release, which should be avoided in patients with a history of asthma.

Morphine

Morphine is a naturally occurring opioid, the prototypical opioid agonist, to which all others are compared. In conscious sedation, doses of 2-4 mg are given intravenously, repeated every 5 minutes up to a total dose of 0.1 mg/kg. Typically a total dose of 5-10mg is given. The duration of action of morphine is 2-3 hours, and the analgesic effect is due at least in part to the action of its active metabolites. For patients who are receiving an analgesic on an outpatient basis, morphine may not be the best choice because of its longer duration of action.

Benzodiazepines

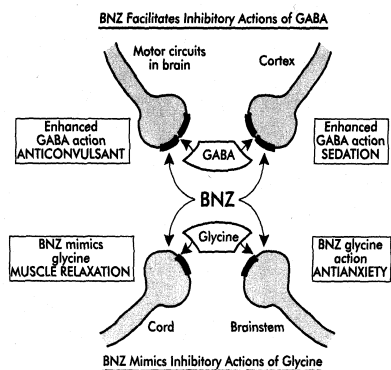


FIGURE 5-1. Through GABA interaction, enhanced inhibition of neurotransmitters occurs, altering normal neuronal function in the central nervous system. (From Richter JJ. Current theories about the mechanisms of benzodiazepines and neuroleptic drugs. *Anesthesiology*. 1981;54:66.)

mechanism of anxiety is unknown, but large numbers of GABA receptors are found in the limbic system of the brain. The limbic system is responsible for emotions, and it is likely that this is the site of action for the anti-anxiety effect of benzodiazepines. Muscle relaxation is achieved with benzodiazepines through direct action on the spinal cord. In addition to receptors located in the CNS, peripheral benzodiazepine receptors have been shown to exist. Their role is not well understood, but may contribute to hemodynamic changes that can accompany sedation. Benzodiazepine receptors have been found in the myocardium, kidney, most cells, platelets and adrenals. Benzodiazepines given alone can cause respiratory depression, although much less so than barbiturates. This effect is accentuated when given in combination with opioids, an important fact to remember when administering conscious sedation. (See graph) It should also be noted that benzodiazepines are contraindicated in acute narrow angle glaucoma.

Diazepam

Given in doses of 1-2 mg slow IV push, diazepam has a duration of action of .25-1 hour. Initial dose may be repeated every 5 minutes as needed, up to a total dose of 0.1 mg/kg.

Oral dosage is 5-20 mg up to a total dose of 0.3 mg/kg. Intravenous diazepam is prepared with a solubilizer, propylene glycol, which can cause local complications such as pain on injection, thrombophlebitis, and venous thrombosis. Diazepam has two active metabolites, desmethyldiazepam and oxazepam, and when given in excess these metabolites may accumulate and prolong the sedation.

Midazolam

When giving midazolam (Versed®), careful titration to effect is important in order to avoid oversedation and respiratory depression. The package insert outlines one method of titration, pointing out that some patients may respond to as little as 1 mg. For patients under age 60, the recommended method is to titrate no more 2.5 mg over a period of at least 2 minutes. An interval of 2 or more minutes should then pass to fully evaluate the sedative effect. If further titration is necessary, the recommended method is to continue to titrate, using small increments, to the appropriate level of sedation, e.g. slurring of speech. Two or more minutes should pass after each increment to fully

Benzodiazepines are sedative-hypnotic drugs, which facilitate neurotransmission at gamma aminobutyric acid (GABA) synapses, a primary inhibitory system in the CNS. There are more than 25 benzodiazepines available including lorazepam (Ativan), diazepam (Valium) and midazolam (Versed). The GABA receptor has at least 2 binding sites, one site for GABA (the natural neurotransmitter), a separate site that binds barbiturates and another site that binds benzodiazepines. Binding of GABA by agonist benzodiazepines or barbiturates causes a conformational change in the receptor site, which opens chloride channels. An influx of chloride ions hyperpolarizes the neuron, making it less likely to transmit an action potential. A continuum of effects can be seen with benzodiazepines with increasing doses, ranging from anxiolysis to anticonvulsant effect, slight sedation, reduced attention, amnesia, intense sedation, muscle relaxation and general anesthesia. The exact

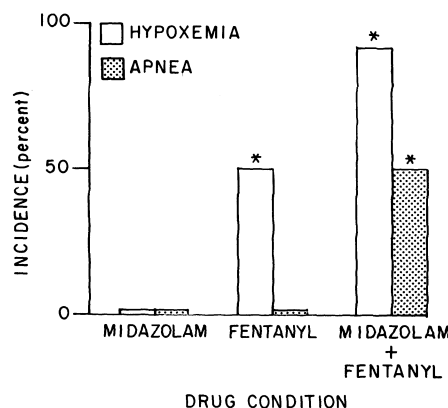
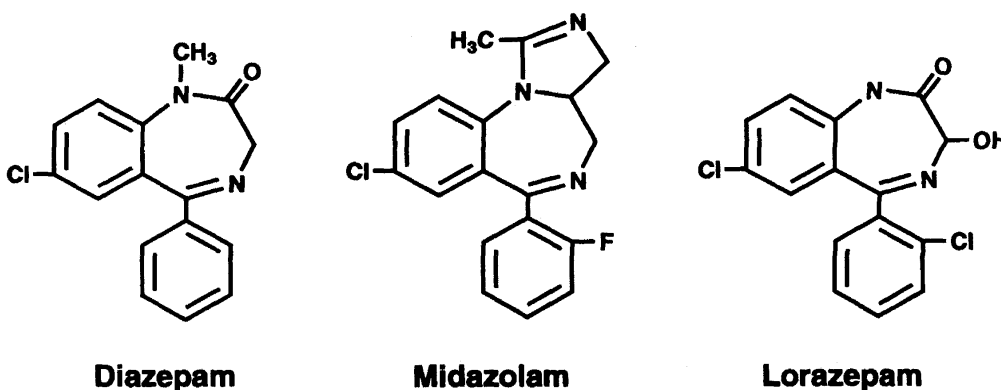


Fig. 4-6 Incidence of hypoxemia and apnea after midazolam (0.05 mg/kg IV), fentanyl (2 µg/kg IV), or both drugs, in young adult volunteers. (From Bailey et al.,¹³⁴ with permission.)

evaluate the sedative effect. Up to a total dose of 0.1 mg/kg may be given but greater than 5 mg is not usually necessary to reach the desired endpoint. If narcotic premedication or other CNS depressants are used, patients will require approximately 30% less Versed than unmedicated patients. The duration of action of midazolam is 1-6 hours, and is usually less than 2 hours.

Lorazepam

Lorazepam possesses the same pharmacological actions as diazepam, but of longer duration. It produces profound anterograde amnesia as an intravenous bolus of 4 mg may produce this effect for up to 24 hours. Doses of 1-2 mg up to a total dose of 0.02 mg/kg may be administered.

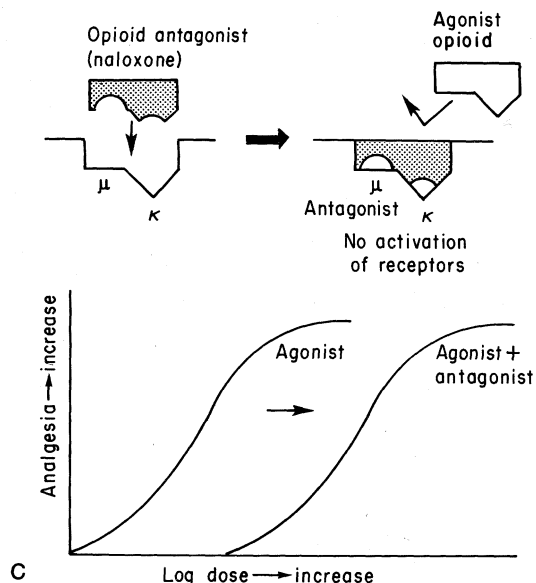


Reversal Agents

An important clinical advantage of opioids and benzodiazepines is the effectiveness of reversal agents. When unwanted side effects (i.e. respiratory depression) are encountered with opioids or benzodiazepines, the reversal agents can be used as "rescue drugs." It should be noted that in cases of overdose of either benzodiazepines or opioids, the side effects might recur as the reversal agent wears off.

Flumazenil

Flumazenil (Romazicon®) acts at the benzodiazepine site of the GABA receptor, but does not cause a conformational change in the receptor. Therefore it acts as a competitive antagonist to other benzodiazepines. In order to reduce the sedation caused by benzodiazepines, 0.2mg should initially be given over 15 seconds. If there is no response, an additional 0.1mg should be given every minute until the desired effect is achieved or a total of 1-2mg has been given. Careful patient monitoring is important after giving this reversal agent as it is when giving naloxone. Duration of action of flumazenil is 30 minutes, and *the patient may become sedated again when it wears off*. Another dose may be given if this occurs, or an infusion may be started.



Naloxone

Naloxone (Narcan®) is an opioid-receptor antagonist used to counteract overdoses of opioid agonists. It antagonizes mu, kappa, delta and sigma receptors. It is indicated for opioid-induced respiratory depression, but also antagonizes analgesia. If given in sufficient quantities to completely reverse analgesia, the intense pain that can be associated with its administration may precipitate a large catecholamine release, resulting in pulmonary edema and even death. Naloxone is distributed in 1ml vials of .4 mg, which should be diluted when given for respiratory depression associated with conscious sedation. Diluting one vial to 10 ml by adding 9 ml of normal saline, and giving 1ml (40mcg) every ½ to 1 minute until adequate spontaneous ventilation resumes is the safest way to administer naloxone in this setting. The duration of action of naloxone is only 10 minutes, *so it is possible that the patient may re-narcotize after receiving naloxone.*

Chloral hydrate

Chloral hydrate is a drug occasionally used for sedation, typically in the elderly or young. It can be administered PO or PR. Pediatric dosage is up to 100 mg/kg, which may be repeated every 30 minutes. A metabolite is thought to be the active substance. Chloral hydrate has no analgesic properties. In normal situations, it has little effect on blood pressure, heart rate or respirations except when mixed with narcotics. Onset of sedation is up to 60 minutes, which decreases the attractiveness of this medication. Side effects include unpleasant taste, epigastric distress, nausea & vomiting, flatulence. CNS disturbances include: lightheadedness, malaise, ataxia and nightmares; laryngospasm, paradoxical excitement, delirium.

Ketamine

This dissociative agent causes a patient to appear conscious (eyes open, swallowing, enhanced laryngeal-pharyngeal reflexes and respiratory stimulation), however the ability to process or respond to sensory input is lost. Through selective disorganization of non-specific pathways in the midbrain and thalamic areas, ketamine produces analgesia, amnesia and unconsciousness. Central sympathetic stimulation occurs with systemic, pulmonary arterial pressure, heart rate and cardiac output increases. The IV dosage is 0.05 mg/ kg, which may be repeated every 10 minutes, up to a total dose of 0.2 mg/kg. Intramuscular doses range from 1-2 mg/kg. Due to the sialagogic side effect of ketamine, at times an antisialagogue such as atropine will be ordered in conjunction with the ketamine. When this occurs, beware of the synergistic effects on the heart rate and blood pressure.

Summary of agents effects on organ systems							
	Cardiovascular		Respiratory		Cerebral		
Agent	HR	MAP	Vent	B'dil	CBF	CMRO ₂	ICP
Benzodiazepines							
Diazepam	0/↑	↓	↓↓	0	↓↓	↓↓	↓↓
Lorazepam	0/↑	↓	↓↓	0	↓↓	↓↓	↓↓
Midazolam	↑	↓↓	↓↓	0	↓↓	↓↓	↓↓
Opioids							
Meperidine*		*	↓↓↓	*	↓	↓	↓
Morphine*		*	↓↓↓	*	↓	↓	↓
Fentanyl	↓↓	↓	↓↓↓	0	↓	↓	↓
Chloral Hydrate	0	0	↓	0	↓	↓	↓
Ketamine	↑↑	↑↑	↓	↑↑↑	↑↑↑	↑	↑↑↑

*The effects of meperidine and morphine on MAP and bronchodilation depend upon the extent of histamine release

HR-Heart Rate; MAP-mean arterial pressure; Vent-ventilatory drive; B'dil-bronchodilation;
CBF-cerebral blood flow; CMRO₂-cerebral oxygen consumption; ICP-intracranial pressure

0 = no effect

0/↑ = no change or mild increase

↑ = increased (mild, moderate, or marked)

↓ = decreased (mild, moderate or marked)

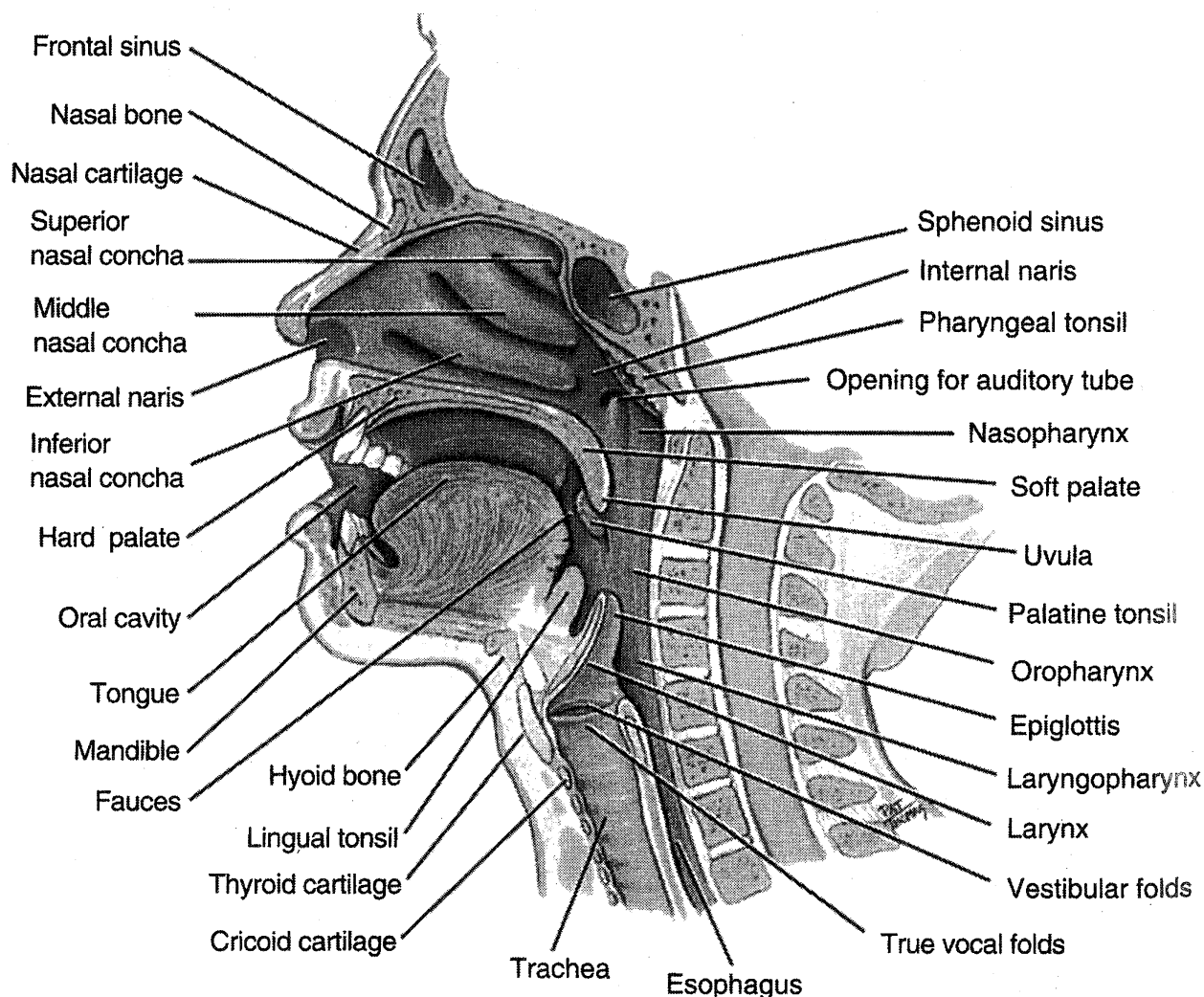


FIGURE 4-1. Anatomy of the upper airway. (From Nagelhout J, Zaglaniczny K. *Nurse Anesthesia*. Philadelphia: WB Saunders; 1997:709.)

In this chapter you will learn basic principles of airway management. Specific techniques and equipment will include the head-tilt/chin-lift, the jaw thrust, oropharyngeal airways, nasopharyngeal airways and bag-valve-masks. Theoretically, airway management should never be an issue during conscious sedation because by definition the patient is able to maintain his own airway spontaneously. However, on occasion sedation/analgesia may inadvertently progress to deep sedation and airway management becomes important. All providers of sedation/analgesia therefore must be familiar with basic airway management techniques. Assessing the adequacy of the airway is the first step to managing it. Visual assessment provides early detection of a failed airway. Many times apnea is a result of airway obstruction, and the patient will continue to ventilate spontaneously as long as the obstruction is removed. When the patient is experiencing airway obstruction, sternal retractions may be observed without the movement of air. This happens typically because soft tissue in the airway, typically the posterior aspect of the tongue, falls back against the posterior pharynx. Several techniques can help this situation, and each must be familiar to the patient monitor.

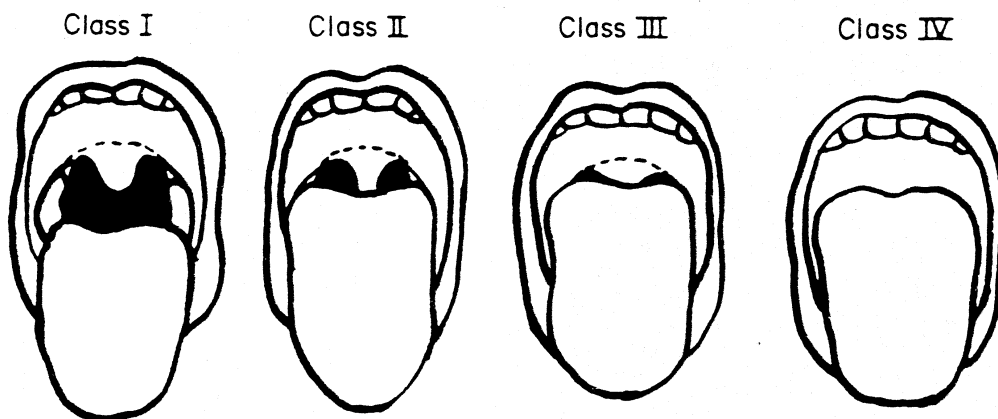


FIG. 4. Classification of tongue size in relation to size of the oral cavity as described by Mallampati.³⁰ Class 1 = soft palate, fauces, anterior and posterior tonsillar pillars, and uvula can be visualized; class 2 = all of the above structures can be visualized except for the tonsillar pillars; class 3 = only the base of the uvula can be visualized; class 4 = none of the structures can be visualized. Reprinted with permission from Benumof.⁹⁷

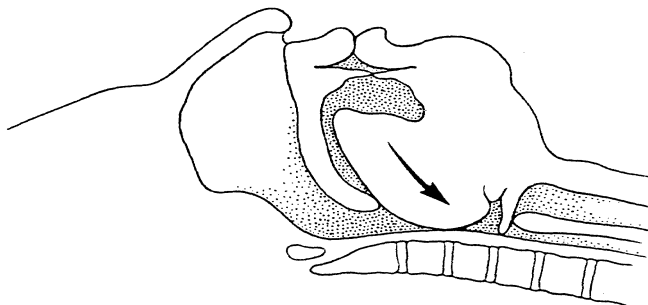
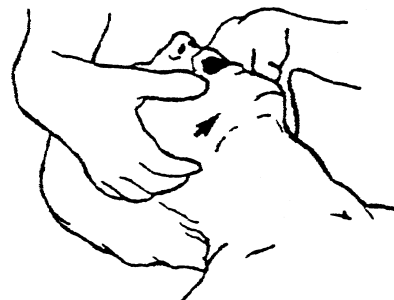


Figure 2-2. Tongue position in the unconscious, supine adult.

Jaw-thrust:

This maneuver is considered slightly more difficult, but is the technique of choice in a patient with a cervical spine injury. One hand is placed on each side of the face, and the mandible is displaced anteriorly using the index or middle fingers pushing against the angle of the mandible. In both of these maneuvers care should be taken to avoid pushing against the soft tissue of the neck or chin.



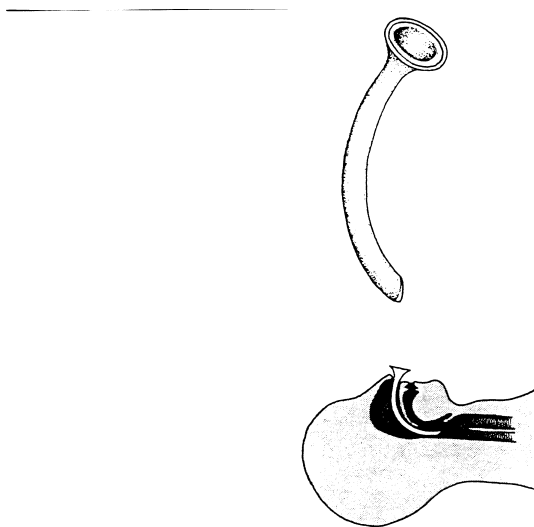
Head-tilt/Chin-lift:

This is an easy maneuver to learn and is the procedure of choice for airway occlusion, according to some. This technique is performed by placing the palm of one hand on the forehead and the fingertips of the other hand on the bony aspect of the chin. The head is tilted backward by gently pushing the chin in the cephalad direction, while stabilizing the forehead. If an open airway is not quickly restored, it may become necessary for invasive measures. Two devices are simple and readily available, the nasopharyngeal airway and the oropharyngeal airway.

Artificial Airways

Nasopharyngeal Airway:

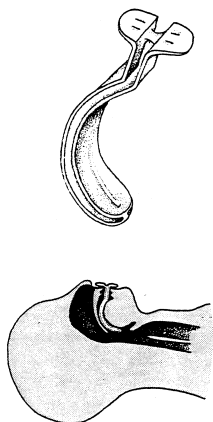
This is a compliant tube approximately 15cm in length designed so that its distal tip sits in the posterior pharynx, with its proximal tip in the naris. This device is usually tolerated well in the semiconscious patient who maintains a gag reflex. Insertion is performed with the assistance of lubricant (a 2% lidocaine lubricant helps anesthetize the soft tissue). The bevel of the airway is positioned against the nasal septum and gentle pressure is applied to slide the device until the flange is at the tip of the naris.



Oropharyngeal Airway:

This device is a semi-curved piece of tubular plastic that is placed on top of the tongue, with the tip in the posterior pharynx. Appropriate size of the device is estimated by choosing an airway that extends from the tragus to the corner of the mouth when held by the patient's cheek. If a tongue blade is available, the airway is inserted right side up over the tongue that is depressed with a tongue blade. If no tongue blade is available, the device can be inserted upside down and rotated 180 degrees when the distal tip reaches the soft palate. Complications of these invasive devices include improper placement, stimulation of vomiting, and bleeding.

Adequate respirations include adequate ventilation and adequate oxygenation. The techniques listed above are designed to aid ventilation and the exchange of carbon dioxide. Several devices designed to improve oxygenation are discussed in the next section.



Oxygen Delivery

Nasal Cannula:

This oxygen administration device delivers oxygen at a rate of 2-6 liters per minute, at concentrations of 24-40%. It is a well-tolerated device and is useful when low oxygen concentrations are desired. In patients with Chronic Obstructive Pulmonary Disease (COPD), hypercarbia loses its value as a stimulus to breath and hypoxia becomes more valuable. In these patients, lower oxygen concentrations are probably more appropriate than high concentrations. The inspired percent of oxygen (FiO_2) is not well controlled with this device, however. Therefore, in a patient with respiratory distress who is breathing through the mouth, an oxygen mask is a more effective oxygen delivery device.

Oxygen Mask:

Three basic styles of oxygen mask are available, the simple mask, the non-rebreathing mask, and the venturi mask. The simple mask has a number of small vents on each side and can deliver up to 50% oxygen. There is a large variability in actual inspired oxygen concentration with the simple mask due to entrainment of room air. The non-rebreathing mask uses flutter valves on each side to prevent entrainment of room air, and uses a reservoir bag to hold a supply of 100% oxygen. This device can deliver up to an inspired oxygen concentration of 90%. The venturi mask is similar to the basic mask, but allows relatively fixed concentrations of supplemental oxygen in concentrations ranging from 24% to 40%.

Bag-valve mask:

A self-inflating resuscitation bag allows manual positive pressure ventilation to a patient who has stopped ventilating spontaneously. With an attached oxygen reservoir and a flow rate of 10-15 L/min, an FiO_2 of up to 90% may be delivered. Due to problems with mask fit, an air leak may prevent adequate ventilation.

Endotracheal Intubation:

The most definitive means of securing an airway in the nonbreathing patient is via a tube placed in the trachea. A correctly placed endotracheal tube with an inflated cuff allows precise control of ventilations and offers protection from aspiration of stomach contents.

Table 3-1. OXYGEN THERAPY

O ₂ Delivery Device	Flow Rate (Liters/min)	O ₂ (%)*
Nasal Catheter	1-8	30-50
Nasal Cannula	1-8	22-50
Simple Mask	6-12	35-60
Partial Rebreathing	6-12	60-90
Non-Rebreathing	6-8	Up to 100
Venturi	(See instructions for particular mask)	24, 28, 35, 40
Oxygen Reservoir Mask	10-16	90

* Approximate ranges for adults

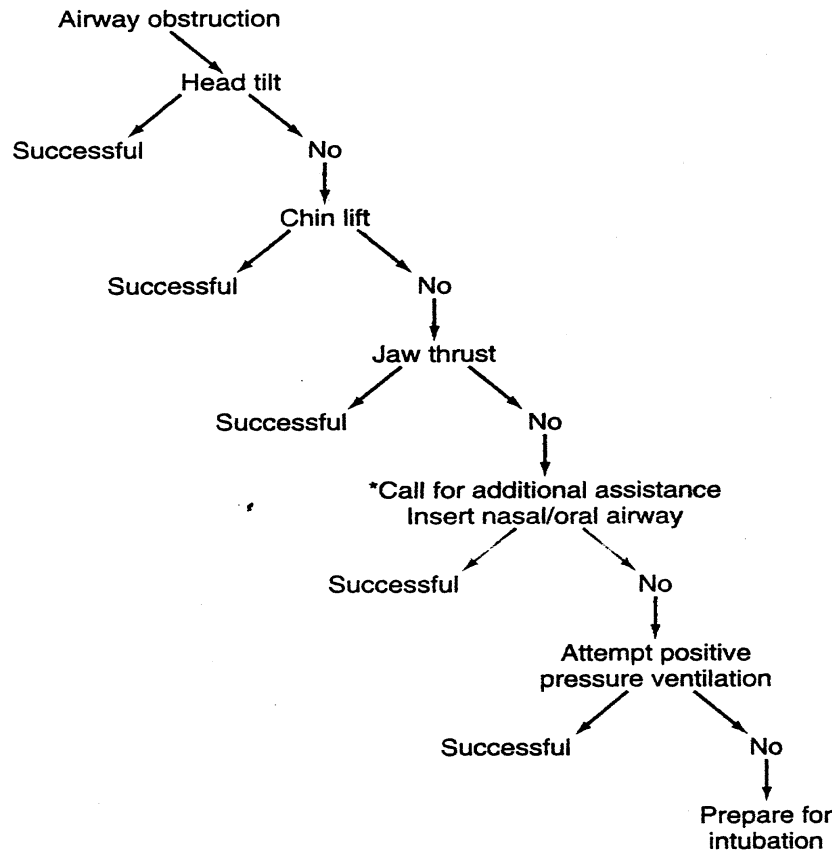


FIGURE 4-11. Conscious sedation airway obstruction algorithm. (© 1996, Specialty Health Consultants.)

LEGAL ASPECTS

When sedation and analgesia are given intravenously, changes in the patient's consciousness and respiratory system can happen quickly, even with small amounts of medication. In order to prevent harm to patients, and legal action against not only the personnel involved, but the institution as well, a review of legal matters will focus on **prevention** of complications.

Responsibilities:

Obtaining informed consent is an important aspect of preventing legal action. It should be noted that personnel other than the physician is responsible for witnessing the signature, but the explanation of the procedure along with risks and benefits is the responsibility of the physician. The person witnessing the signature does have the responsibility of insuring that the patient knows what they are signing. If the patient cannot read English or understand the document, then the witnessing individual would be negligent to simply have them sign the form.

Monitoring the patient and insuring patient safety is a responsibility of everybody involved, including the physician performing the procedure, the other team members involved and the institution where the procedure is taking place. This may include a person who is not present when an adverse event occurs, such as a person who took an inadequate history that led to an adverse event. Lawsuits involving anesthetic agents are difficult to defend because the patient

has no control over the outcome, and because the outcomes are usually severe (i.e. death or brain damage). However, adverse outcomes usually do not result from a single mistake, rather a series of mistakes usually occur to cause the adverse outcome. When defending the suit, standard of care issues will be raised. Authoritative bodies such as The American Society of Anesthesiologists and The American Association of Nurse Anesthetists will be consulted in order to review current practice standards. The standards from these organizations are not typically well known by the team members, but the sedation/analgesia protocol was designed around them. It is important, therefore, that the patient monitor be very familiar with the institution's sedation/analgesia protocol.

Proof:

A patient who brings legal action against the patient monitor must first prove that there was a duty between the patient monitor and the patient. This is not difficult to prove in cases involving intravenous sedation; the relationship is usually obvious unless this team member was misnamed. The plaintiff must then prove a breach of duty. This means they must prove that something was done wrong or negligently.

Protection:

In addition to becoming familiar with the protocol, there are some other measures that can protect the patient monitor from involvement in lawsuits. Attending seminars and acquiring specialty certifications such as Advanced Cardiac Life Support (ACLS) show attention to the issues at hand. Safety should always be the primary concern. If there is an option between a safe method and a quick method, the safe method should always be chosen. Doses of emergency medications should all be calculated before the procedure begins. Defending cases where medications were given incorrectly is nearly impossible.

POST-TEST

1. You have given your patient a small dose of an anxiolytic and a small dose of analgesic in preparation for an uncomfortable procedure. The patient remains alert and denies any feelings of sedation. Select the level of sedation this patient has received.
 - A. No sedation
 - B. Minimal sedation
 - C. Moderate Sedation
 - D. Deep Sedation

2. A patient who has been medicated prior to a colonoscopy is snoring loudly and occasionally appears to have sleep apnea. When the nurse shakes his shoulder he arouses and takes a deep breath. This description most accurately describes which of the following?
 - A. Minimal sedation
 - B. Moderate Sedation
 - C. Deep Sedation
 - D. Anesthesia

3. Flumazenil is a(n):
 - A. Opioid
 - B. Benzodiazepine agonist
 - C. Benzodiazepine antagonist
 - D. Non-steroidal anti-inflammatory (NSAID)

4. All of the following are true **EXCEPT**:
 - A. 1 vial of naloxone can safely be given as a bolus to the average-sized adult.
 - B. Flumazenil reverses benzodiazepines.
 - C. Naloxone reverses opioids.
 - D. Naloxone may precipitate pulmonary edema.
 - E. After reversal of opioids, care must be taken to monitor for the possibility of another onset of respiratory depression.

5. You have given a patient an intravenous dose of a medication that acts on mu receptors. You have given a(n):
 - A. Opioid
 - B. Benzodiazepine agonist
 - C. Benzodiazepine antagonist
 - D. Non-steroidal anti-inflammatory (NSAID)

6. Which of the following situations is **NOT** covered by the sedation/analgesia protocol?
 - A. Administering a prophylactic barbiturate for seizure control to a patient on the ward.
 - B. Administering a barbiturate suppository to a child in the emergency room prior to a painful procedure.
 - C. Administering morphine to a post-op patient on the ward for a dressing change.

- D. Administering an anxiolytic to a patient in the GI lab during a colonoscopy.
7. Which 1 of the following situations does **NOT** require consultation with the anesthesia department?
- A. A 90 year-old woman presents for an EGD and requires sedation.
 - B. A 30 year-old multiple trauma patient has a jaw wired shut and requires sedation prior to an uncomfortable procedure.
 - C. A 55 year-old with severe COPD requiring sedation for a bronchoscopy.
 - D. A 55 year-old with no prior medical history has a scalp wound and requires sedation and analgesia for suturing.
8. Sedation/analgesia competency validation must be revalidated how often?
- A. One time only
 - B. Every 6 months
 - C. Every year
 - D. Every 2 years
9. Pulse oximetry readings of 98-100% indicates adequate ventilation.
- A. True
 - B. False
10. All of the following must be documented at least every 5 minutes during a procedure utilizing sedation/analgesia **EXCEPT**:
- A. Temperature
 - B. Pulse
 - C. Respiratory Rate
 - D. Blood Pressure
 - E. Oxygen Saturation
 - F. Level of Consciousness

11. According to the study guide, what PaO₂ correlates with a SaO₂ of 90%?

- A. 60 mmHg
- B. 70 mmHg
- C. 80 mmHg
- D. 90 mmHg

12. A blood pressure cuff that is too small for the patient would cause the monitor to display a reading that is:

- A. Falsely low
- B. Falsely high
- C. Accurate
- D. Accurate except for the pulse rate.

13. The remaining questions refer to the following scenario. As new information becomes available in the scenario, it will be displayed in **bold print**.

You are the nurse who is providing sedation/analgesia for a patient undergoing an ERCP (endoscopic retrograde cholangiopancreatography) to diagnose occlusion of the common bile duct due to gallstones. The patient is a 61 year-old female weighing 155 pounds and has no cardiac, pulmonary or other major systemic diseases and no allergies. The patient must be positioned in a lateral; almost prone position and a scope will be passed through the mouth and stomach into the common bile duct. The patient must remain still to prevent perforation.

Based on body weight, an appropriate maximum dose of midazolam for this patient (if given by itself) would be in what range?

- A. 1-2 mg
- B. 3-5 mg
- C. 6-7 mg
- D. 8-9 mg

14. Based on body weight, an appropriate maximum dose of morphine for this patient (if given by itself) would be in what range?

- A. 1-2 mg
- B. 3-5 mg
- C. 6-7 mg

D. 8-9 mg

15. An appropriate naloxone dose schedule for this patient would be:

- A. 1 vial (.4mg) every 1-2 minutes until adequate respirations are achieved.
- B. 1/2 vial (.2mg) every 1-2 minutes until adequate respirations are achieved.
- C. 1/3 vial (.12mg) every 1-2 minutes until adequate respirations are achieved.
- D. 1/10 vial (.04mg) every 1-2 minutes until adequate respirations are achieved.

16. An appropriate flumazenil dosing schedule for this patient would be:

- A. 0.2 mg every 1-2 minutes until the patient arouses adequately.
- B. 0.4 mg every 1-2 minutes until the patient arouses adequately.
- C. 1.0 mg every 1-2 minutes until the patient arouses adequately.
- D. 2.0 mg every 1-2 minutes until the patient arouses adequately.

17. **You have completed the necessary pre-procedural exam, applied the required monitors, assembled the appropriate equipment and positioned the patient. The physician orders 2mg of Versed IV.**

The patient's status is as follows:

Blood Pressure: 120/80 mmHg

Pulse: 85 bpm

Respiratory Rate: 16

Oxygen Saturation: 99%

Gross Motor Movement: patient is looking around the room

Level of Consciousness: awake and following all commands, appears anxious

Amount of midazolam given so far: 0 mg

Amount of morphine given so far: 0 mg

Amount of flumazenil given so far: 0 mg

Amount of naloxone given so far: 0 mg

Choose the best course of action:

- A. Titrate in the ordered dose of medication, giving half of the dose at a time, and stop sooner if the desired end-point is reached.
- B. Refuse to give any of the ordered medication.
- C. Give the full ordered dose of the medication as a bolus.
- D. Consult anesthesia and cancel the procedure.
- E. Encourage the patient to take a deep breath.

18. Some of the equipment for the procedure is not functioning properly, and there is a lag period where the patient is receiving no stimulation as the equipment is being prepared.

The patient's status changes as follows:

Blood Pressure: 100/75 mmHg

Pulse: 75 bpm

Respiratory Rate: 8

Oxygen Saturation: 94%

Gross Motor Movement: still

Level of Consciousness: eyes are closed, responds to verbal commands

Amount of midazolam given so far: 4 mg

Amount of morphine given so far: 0 mg

Amount of flumazenil given so far: 0 mg

Amount of naloxone given so far: 0 mg

What is your best course of action at this time?

- A. Request an order for flumazenil.
- B. Request an order for naloxone.
- C. Request an order for more midazolam.
- D. Request an order for morphine.
- E. Cancel the procedure and consult anesthesia.
- F. Encourage the patient to take a deep breath.

19. The equipment is now functioning properly and the procedure is begun. As the scope is passed through the pyloric sphincter the patient's condition is as follows, and the physician orders 4mg of morphine.

Blood Pressure: 170/90 mmHg

Pulse: 100 bpm

Respiratory Rate: 18

Oxygen Saturation: 98%

Gross Motor Movement: moving head and shoulders, vocalizing

Level of Consciousness: eyes are open, responds to verbal commands

Amount of midazolam given so far: 4 mg

Amount of morphine given so far: 0 mg

Amount of flumazenil given so far: 0 mg

Amount of naloxone given so far: 0 mg

An appropriate course of action for you at this point would be what?

- A. Titrate in the ordered dose of medication, giving half of the dose at a time, and stop sooner if the desired end-point is reached.
- B. Refuse to give any of the ordered medication.
- C. Give the full ordered dose of the medication as a bolus.
- D. Consult anesthesia and cancel the procedure.
- E. Encourage the patient to take a deep breath.

20. More medication is titrated as needed to complete the procedure, which continues uneventfully and the patient remains stable and comfortable. When the procedure is completed, the patient is transported to the recovery area where you continue to monitor the required parameters. Shortly after the patient arrives in the recovery area you cannot arouse her and she is not maintaining adequate oxygen saturation. You realize an error in morphine administration was made toward the end of the procedure.

The patient's status is now as follows:

Blood Pressure: 100/60 mmHg

Pulse: 60 bpm

Respiratory Rate: 6

Oxygen Saturation: 90%

Gross Motor Movement: still

Level of Consciousness: requires encouragement to breathe, but arouses with encouragement.

Amount of midazolam given so far: 4 mg

Amount of morphine given so far: 15 mg

Amount of flumazenil and naloxone given so far: 0 mg

An appropriate course of action for you at this point would be what?

- A. Continue to encourage the patient to breathe, hoping that the situation will not deteriorate.
- B. Request an order for flumazenil.
- C. Request an order for naloxone.
- D. Request an order for oxygen via face mask at 7 l/m.

Sedation/Analgesia Patient Monitor Course Test Answer Sheet

Name: _____

Date: _____

Duty Station/Clinic: _____

Write your answer next to the appropriate number.

1. _____ 11. _____

2. _____ 12. _____

3. _____ 13. _____

4. _____ 14. _____

5. _____ 15. _____

6. _____ 16. _____

7. _____ 17. _____

8. _____ 18. _____

9. _____ 19. _____

10. _____ 20. _____

SCORE: _____

CHIEF, ANESTHESIA SERVICE

RETURN THE ANSWER SHEET TO:

**CDR USAMEDDAC
ATTN MCXR DN ANE LTC ALBEE
2480 LLEWELLYN AVE**

FORT MEADE MD 20755-5800